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USING MODERN TECHNOLOGIES TO UPGRADE EDILITARY URBAN INFRASTRUCTURE

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Abstract. *Adopting the European laws concerning environmental protection will require sustained efforts of the authorities and communities from Romania; implementing modern solutions will become a fast and effective option for the improvement of the functioning systems, in order to prevent disasters. As a part of the urban infrastructure, the drainage networks of pluvial and residual waters are included in the plan of promoting the systems which protect the environmental quality, with the purpose of integrated and adaptive management.*

The paper presents a distributed control system for sewer network of Iasi town. Unsatisfactory technical state of the actual sewer system is exposed, focusing on objectives related to implementation of the control system. The proposed distributed control system of Iasi drainage network is based on the implementation of the hierarchic control theory for diagnose, sewer planning and management. There are proposed two control levels: coordinating and local execution. Configuration of the distributed control system, including data acquisition and conversion equipment, interface characteristics, local data bus, data communication network, station configuration are widely described.

The project wish to be an useful instrument for the local authorities in the preventing and reducing the impact of future natural disasters over the urban areas by means of modern technologies.

1 INTRODUCTION

The floods in the past years proved that the urban systems in the big cities have became one of the major pollution factors, which affects the life quality of the inhabitants in all forms: ecological security, comfort, health. Realized a long time ago, projects based on natural water flow in draining channels has proved inefficient, in the condition of heavy rainfall. Rehabilitation of the whole drainage network would be very expensive and can last dozens of years. Thus, modernization done by implementing monitoring and control systems, for a better use of the existing channels, seems to be the only short time solution. The factors that determine network overload are very diverse and difficult to control: the structure of the network, rainfall, the structure of the population, relief elements. This is why the development of a new model requires a new systemic approach. The goals are:

- the evaluation of the parameters that influence the process of collecting and evacuating of the pluvial urban water;
- the analysis of the impact against inhabitants and other facilities in the area;
- the development of a methodology to gradually realize modern systems to control urban infrastructure;
- the development of monitoring solutions and control by simulating crisis situations using models;
- elaborating urban proposals cooperating with local decision factors.

2 STATE OF THE ART

Only this year Romania was stroke by four major floods, causing damages estimated at over 2 billions EU. Over 25.000 houses were wrecked, 40 people lost their lives, and hundreds of km of roads, railways and bridges were affected[5]. Tornados, a phenomena new in the region, caused smaller catastrophes, comparing to the land slides produced by the unusual quantity of rainfall. Due to the disasters caused by floods (fig.1), it is necessary now, more then ever, to take advanced care for the environmental protection and improvement of the urban environment, which can bring several advantages in the urban planning, and also in the zonal planning [4].

Fig.1 Urban Flooding (Bacău, 2005)

As a part of the urban infrastructure, the drainage networks of residual waters are included in the plan of promoting the systems which protect the environmental quality, with the purpose of integrated and adaptive management.

The analysis of the catastrophic floods proved that the urban flooding effects can be reduced by engineering projects and better monitoring and control systems for the crisis management [2]. The concept of using modern technologies for the protection of urban areas against floods, is debated in the present project. The goal is promoting technologies and high performance equipment, in order to minimize pollution and problems caused by climatic changes-floods.

Urban drainage system of Iasi, past one hundred and ten years old, whose first modernization was in year 1910 deals with combined drainage of urban waters. The total area of the Iasi town is 3600 ha and the sewer system catchments are more than 80%. Technical state of the sewers is unsatisfactory. Since in latest 30 years asphalted and paved surfaces were growing, the sewer system, especially main collectors, don't deal with current flows in storm periods, leading to hydraulic problems and flooding. Thus, experience has showed that regular management of urban waters collecting and transport can become inefficient at polluting overflows occurrence. Urban development increases the runoff volume and the risk of flooding might become worse over the years.

Conventional design of Iasi urban drainage system focused on conveyance of runoff flows and neglected water quality considerations. There are used simple local controls, like flow pumping in low lying areas. Few information available from the network are usually uncertain, because of the lack of interest of people which gathered them and because of the network capacities and topology. Thus, it was decided that more precise data could be collected by using modern monitoring and control systems [3][6].

3 MANAGEMENT CONCEPT

The proposed distributed control system of Iasi drainage network is based on the implementation of the hierarchic control theory for diagnose, sewer planning and management. There are proposed two control levels: coordinating and local execution (fig.2). The catchments area is divided in many regions. Data acquisition, conversion and collecting by a microcontroller are realized at local level. The decision referring to further execution actions, based on information from the entire system is elaborated at coordinating level[1].

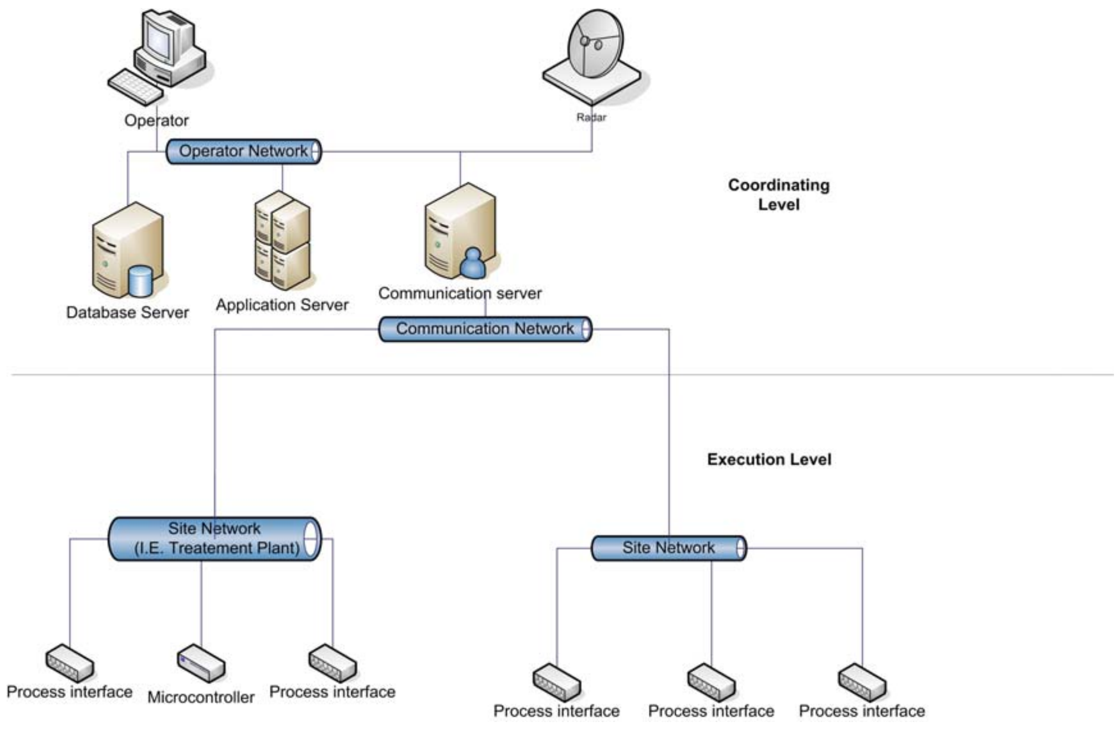

Fig. 2 Hierarchic System Structure

The usually measured parameters in urban drainage systems are water level, flow and velocity. There are also other monitoring parameters, like temperature, biological characteristics, and fluid volume. Because basic elements which describe flow could found using specific mathematical relations, water level transducers are very important measurement elements. Accuracy, reliability, calibration and maintenance conditions are the main criteria in selecting the measurement network.

Conversion of the measured parameter into an unified electrical signal (voltage or amperage) is realized by transducers. The proposed optimal solution uses transducers with RS485 interface, because it simplifies the cabling system and reduces the cost, eliminating analog-digital converter. Besides, some transducers could be integrated in control elements, giving the possibility of controller implementation. However, analog digital converters should be used in case of transducers with analog output only. Transducers equipping varies depending on number of input/output channels, existence of regulators, importance of the measurement node from the viewpoint of modeling process and modeling stage.

Digital signal can be easily transported by local data bus to microcontroller and to the next control level. The control systems using RS485 bus offers many advantages like low costs, reduced maintenance, flexibility operation and safety. The computer could control all the bus connected sensors through a modem with RS485 interface.

The distributed and hierarchic data acquisition system uses local programmable logical microcontrollers (PLC), which make more efficient the flux of data towards central computer. Depending on the nature and importance of information, data from different measurement points could be sampled with different optimal frequencies, stored in the local memory and sent to central computer. For system identification purposes, when real time control problem is not important, the communication costs are significantly reduced, referring to long duration of identification experiment.

Implementation of TCP/IP protocol is also possible by using microcontrollers, thus creating a standard information system, with flexibility and portability features. Implemented protocol allows that microcontroller requests could be recognized by any standard *dial in* server (Unix, Windows NT, Windows XP or Novel Netware -versions with IP support). The server could also examine the sites without a proprietary communication protocol.

The local electronic devices, data acquisition and control modules are connected to a RS485 local bus, with or without local PLC and appropriate process interfaces (fig.3). RS485 serial bus is used as the local bus because of its advantages: support for many interfaces on the same bus, saving cable, long distances between measurement point and communication node, satisfactory communication rates, low costs and noise immunity.

Data acquisition and command transmission are realized by established communication system. Modems on switched telephonic lines link central by local sites, at time intervals depending on the priority level. In normal mode, used for acquisition, surveying, identification, local system records only parameter modifications, comparing to preset values. In alarm priority mode, local system calls central computer announcing the new state, acquiring data in real time and sending them to the coordinating level. This solution represents the core of the real time control system.

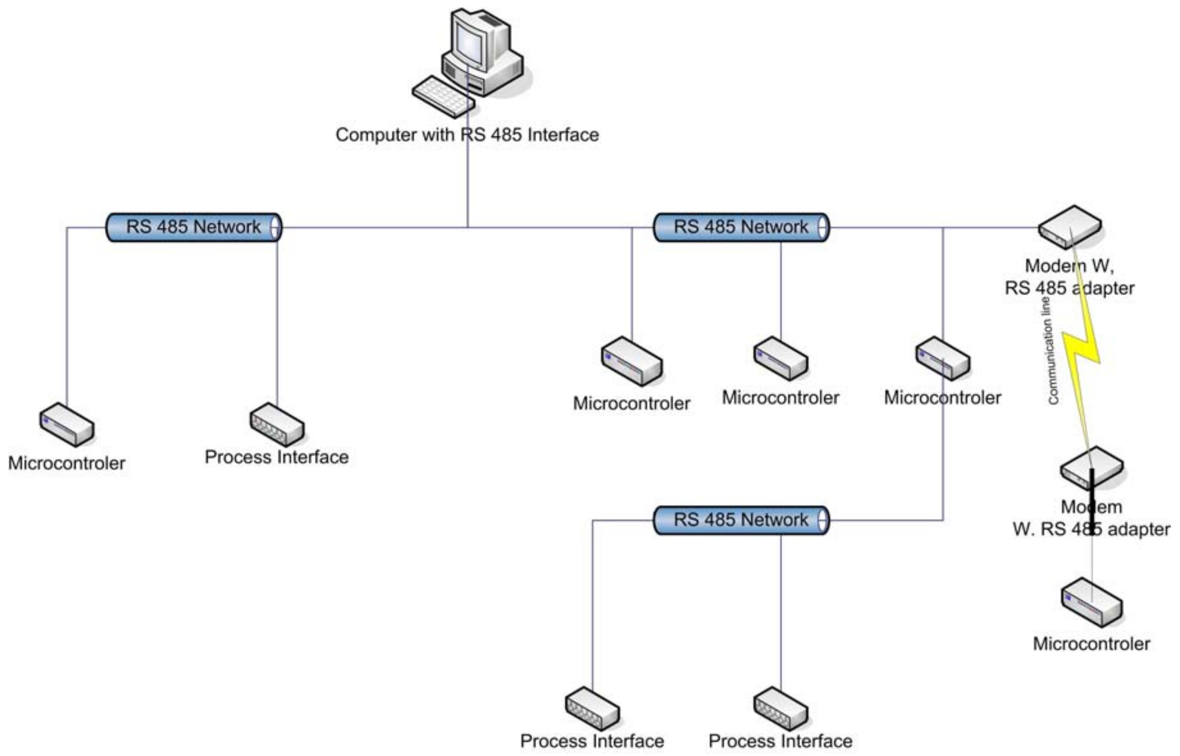

Fig. 3 RS 485 Network Structure

To analyze flow distribution on various collectors in the monitoring phase, the measurement points have to be placed in sewer ramifications and at the regulators sites. Collected data will be essentials for the study of the drainage system behavior in the real time control phase. Thus each one of the ten proposed measurement points give information about the every collector contribution at the urban flow. Besides the above mentioned measurement points, there are also other informational points. Central dispatcher, placed in treatment station, can be used especially in the model development phase, because it can give information about pollution level and components. Informational point placed at Water Company, manages global data about the system, useful for the intervention crew alarming and for the other companies. Radar station gives information about rain measurements and predictions. Urban weather station, equipped with an automated device (Campbel Scientific) has remote interrogation and memory storage facilities.

Thus, Design Department could access the model and database, using the obtained information for system development. The network map with main parameters, including weather information is displayed on the operator console. The system acquisition support and data achieving capabilities could be realized by a graphical interface (LabView). Current database give information about system behavior at different stages of operation. The operator can access the “operator guide” mode which, based on the model and on a specialized software (Hydroworks) could predict the future behavior of the sewer system, depending on different control decisions. The system will follow the parameter evolution and the adjusted model will permanently improve its parameters based on previous prediction and on the acquired results from the system.

4 CONCLUSIONS

Adopting the European laws concerning environmental protection will require sustained efforts by the authorities and communities from Romania; implementing modern solutions will become a fast and effective option for the improvement of the functioning systems, in order to prevent disasters. One of the priorities is the urban development, in order to insure the quality of the environment, severely damaged in the past years by the locality's dynamics changing, the climate and pollution modification, by the inappropriate exploitation of the natural resources and last but not least, by the state of old technical infrastructure.

The monitoring and control system proposed use process data to operate regulators during the flow process. Pumps, sluice gates, weirs, etc, should be controlled to allow adverse effects (flooding, combined sewer overflows) only if the system is at the capacity and at the locations where the least damaged is caused. Thus a careful analysis of the process, from rainfall and waste water input into the collection system, to the treatment plant and to the pollution impact on the receiving waters is necessary. Optimum use of storage capacity, minimizing urban drainage overflows and alleviating the impact flow to the treatment plant can be realized by controlling the flow process through measurements and regulators.

The project wish to be an useful instrument for the local authorities in the preventing and reducing the impact of future natural disasters over the urban areas. The contributions that result from the proposed solutions aim the foundation and utilization of a system in order to reduce the natural risk impacts over the environment, with direct reference to urban settlements. Priority since the floods in 2005, the land planning and the urban development by project modernization will be an important subject of research on national plan.

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